

MORAVIAN POTTERY AND TILE WORKS

Swamp Road
Doylestown
Bucks County
Pennsylvania

HAER No. PA-107

HAER
PA
9-DOYLT.V,
8-

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HISTORIC AMERICAN ENGINEERING RECORD

MORAVIAN POTTERY AND TILE WORKS
HAER No. PA-107

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9-DOYLT.1
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Location: Doylestown, Bucks County, Pennsylvania. Southwest side of State Route 313 (Swamp Road), northwest of East Court Street.

Date of Construction: 1911-12, 1916

Present Owner: Bucks County Department of Parks and Recreation
Division of Historic Properties
Swamp Road
Doylestown, Pennsylvania 18901

Present Use: Ceased tile manufacture in early 1960s. Re-opened as a museum in 1969. Tile manufacture resumed 1975. Currently operated as a working factory and living history museum.

Significance: The Moravian Pottery and Tile Works is a rare surviving example of a successful and influential American Arts and Crafts tile factory. Its original architecture, machinery, kilns, tile molds, and business records remain largely intact, providing an unequalled record of the technical, economic, and aesthetic activities of an early twentieth-century American art pottery. Designed by archaeologist, architect, collector, and scholar Henry Chapman Mercer (1856-1930), the factory was built of reinforced concrete in the style of Southern California mission architecture. It was declared a National Historic Landmark in 1985.

Historian: David B. Driscoll

Introduction

The Moravian Pottery and Tile Works is a two-story, reinforced concrete tile factory constructed by Henry Chapman Mercer (1856-1930) between 1911 and 1916 in Doylestown, Pennsylvania. Built with the motifs and forms of Southern Californian mission architecture, such as tile-roofed towers and an arcaded courtyard, the Tile Works housed a successful Arts and Crafts movement tile business in the early decades of the 20th century. The factory was operated by several owners after Mercer's death, and was ultimately purchased by Bucks County.

The coarse-aggregate concrete used for the factory was mixed and cast by hand, yielding a highly textured surface of varied porousness. The roof tiles, as well as the decorative tiles adorning the exterior walls and chimneys, are of Mercer's own manufacture. The structural reinforcing techniques were standard, even somewhat unadvanced for the period, but Mercer's form work departed dramatically from the mainstream practice of the time. Mounded-earth forms were used to cast the building into complex, irregular, vaulted shapes.

Production techniques at the Moravian Pottery and Tile Works reflected Mercer's Arts and Crafts sensibilities. In keeping with his belief that 19th century dry-pressing technology had robbed contemporary tile of all art and humanity, tiles were manufactured here in a plastic state, largely by hand. The factory employed eighteen men at its peak. Until Mercer's death in 1930, Moravian tiles were both popular and stylistically influential. The Moravian Pottery and Tile Works is both the idiosyncratic creation of an exceptional individual, as well as a sophisticated and practical realization of larger American Arts and Crafts movement ideals.

Biographical Background

Because the appearance and function of the Moravian Pottery and Tile Works grew so directly out of Henry Mercer's personal experiences and interests, it is helpful to know something of Mercer himself in order to understand his buildings.¹ Interconnected interests in history, art, and archaeology influenced virtually all of Mercer's adult endeavors. Although trained as a lawyer and admitted to the Philadelphia County Bar in 1881, Mercer quickly adopted archaeology as his chosen career. At a time when an interested amateur could rise to scholarly prominence, Mercer did just that. In 1885 Mercer published his first archaeological monograph, and in 1891 was appointed one of ten managers of the Free Museum of Science and Art (later renamed the University Museum) at the

¹The following summary of Henry Mercer's career is based largely upon Linda Dyke, "Henry Chapman Mercer (1856-1930): An Annotated Chronology," an unpublished manuscript compiled for the Fonthill Museum by its assistant curator.

University of Pennsylvania.² In this capacity he began his formal excavations of Native American sites in the eastern United States and the Yucatan Peninsula of Mexico. Mercer served as the Museum's Curator of American and Prehistoric Archaeology from 1894 to 1897. Throughout these years, he sought to demonstrate the existence of prehistoric man in the New World.

Failing to find the conclusive evidence he sought and forced out of the University Museum by professional disagreements and his own unwillingness to compromise, in 1897 Mercer turned his attention to the more recent past. Mercer reasoned that modern cultures, like ancient ones, could be understood through their material remains. He began to assemble an extensive ethnological collection of pre-industrial American tools and technology, and eventually built a reinforced concrete building to house it. The building and its contents now comprise the Mercer Museum of the Bucks County Historical Society in Doylestown, Pennsylvania.

"Archaeology turned me into a potter," Mercer explained in a 1928 interview.³ His exploration of pre-industrial crafts led Mercer to an interest in Pennsylvania German pottery-making. After a brief apprenticeship with a Bucks County potter in 1897, Mercer was determined to establish a functioning pottery of his own.⁴ By 1900 his Moravian Pottery and Tile Works was a financial success. The business achieved a national reputation in 1904 when it won a gold medal at the St. Louis World's Fair. For the rest of his life, Mercer continued to design both individual tiles and architectural installations.

Between 1903 and 1906, Mercer began his architectural career by constructing several concrete sheds at his pottery. In the winter of 1907 he designed his first major building, his reinforced concrete dwelling, Fonthill. Construction began in the spring of 1908, and Mercer took up residence there in 1912. He continued to embellish the interior with artifacts, prints, and tiles until 1929. Mercer went on to design and build, also of reinforced concrete, a new pottery (1911-12, 1916) and a museum to house his collection of pre-industrial tools (1913-1916). Mercer drew architectural inspiration for these buildings from his extensive European travels and his study of art and architecture. The startlingly original designs of these buildings, however, express Mercer's unique personal aesthetic. All three buildings were named National Historic Landmarks in 1985.

Mercer once summarized the influences upon his tile-making as "veneration

²The Lenape Stone, or the Indian and the Mammoth (New York and London: G. P. Putnam's, 1885).

³Rose C. Feld, "Unique Museum Links Antiquity to Today," New York Times 19 February 1928.

⁴Mercer described his early experiences with clay and the founding of the MPTW in "Notes of the Moravian Pottery of Doylestown," Bucks County Historical Society Papers 4 (1917), 482-87.

for the past, ... great love of letters, great interest in the technical histories and industries; several visits to Europe; my experience in Archaeology and Museums; [and] consultations with the friends who have studied directly the clay work of primitive peoples."⁵ These same factors influenced the design, construction, and use of the Moravian Pottery and Tile Works. They produced a building which served a practical industrial function while expressing a complex historical and aesthetic world view.

Architectural Background

The current structure is the second location of the Moravian Pottery and Tile Works. The first pottery was located nearby at the family's Doylestown estate of Aldie. The current factory, built after the business had been operating for a dozen years, is referred to in the Tile Works records as "the New Pottery." Mercer's decision to use reinforced concrete for the New Pottery was not an arbitrary or sudden one. The techniques and possibilities of concrete construction were being explored with enthusiasm in the first decade of the new century, and Mercer was surely aware of them.⁶ The Moravian Pottery and Tile Works supplied decorative tile for the Marlborough Hotel in Atlantic City, N.J., which was, at the time of its construction in 1905-06, the largest reinforced concrete building in the world.⁷ How much his familiarity with the Marlborough Hotel project inspired Mercer to undertake the large-scale construction of Fonthill in 1908 is open to speculation. Mercer had, however, been experimenting with concrete construction at the first Moravian Pottery. Mercer's annual financial summary for 1905-06 lists an improvement of "1 cement Bldg. Around Kiln."⁸ In his "Notes on the Moravian Pottery of Doylestown," Mercer described his first pottery: "The first two kilns were constructed in a woodshed adjoining the Indian House, after which two larger kilns were built in a fireproof shed, constructed of tin, clay, and cement, since demolished, several hundred yards in the rear."⁹

During these years of experimentation, Mercer took pains to educate himself about the nature and techniques of concrete construction. A notebook he kept during this period contains information on concrete recipes and reinforcing techniques, as well as directions for waterproofing concrete and casting cement on

⁵HCM to William Hagerman Graves, 11 November 1925, MPSTL.

⁶Carl W. Condit, American Building: Materials and Techniques from the Beginning of the Colonial Settlements to the Present (Chicago: University of Chicago Press, 1968). pp. 155-176, 240-250.

⁷Condit, p. 241. The Marlborough Hotel was designed by the Philadelphia architectural firm Price and McLanahan, with whom the MPTW did extensive business between 1903 and 1920. William L. Price displayed Arts and Crafts ideals similar to Mercer's in his sponsorship of the artist colony at Rose Valley, Pennsylvania. The Marlborough Hotel is order 1906-01A in the MPTW Records, Series 1 and 2, MPSTL.

⁸Sales/Expense Books, MPTW Records, Series 9, Vol. 1, p.65, MPSTL.

⁹"Notes," p. 483.

sand.¹⁰ The notebook also indicates that Mercer was already experimenting with the use of decorative earthenware roof tiles. The only surviving photograph of the fireproof building at the first pottery shows a concrete roof partially covered by flat quarry tiles in a shingle-like pattern.¹¹

Using the information and experience he had been acquiring for several years, Mercer began construction of Fonthill in the spring of 1908. He personally supervised a crew of between 8 and 10 laborers who built Fonthill in the summers of 1908, 1909, and 1910.¹² The following spring he moved his crew 500 feet to the north and broke ground for the New Pottery on March 15, 1911.¹³

Construction of the New Pottery, 1911-1916

Documentation for the construction of the New Pottery comes from several sources, most importantly Mercer's construction notebooks.¹⁴ Mercer kept a notebook during the construction of each of his buildings, in which he recorded architectural sketches and dimensions, technical information, construction techniques, progress reports, and other miscellaneous information. By far the most detailed of these is the Fonthill notebook. Fonthill was Mercer's first and most elaborate full-scale building, and the notebook contains considerable technical information about concrete recipes, reinforcing and forming techniques, and methods of finishing and waterproofing. The Tile Works notebook is much less detailed, containing primarily sketches of the building and progress reports. Presumably by the start of work on the New Pottery in 1911, Mercer was familiar enough with his materials and techniques that he felt no need to record them again in detail.

Additional information about Mercer's construction techniques is contained in his published account of the building of Fonthill, in various MPTW business records, in historic photographs, and in the physical structure of the building

¹⁰"Tile Setting Instructions and Other Notes," MPTW Records, Series 10, Vol. 5, MPSL. Several of the entries in the notebook date it to 1905-06.

¹¹This roof and its method of construction were described by HCM in Robert W. Lesley, "A Tile-Concrete Roof," Cement Age 4 (April 1907), 248-49. The tiles were purely decorative; the concrete itself had been waterproofed to keep out the rain.

¹²HCM, "The Building of Fonthill at Doylestown, Pennsylvania, in 1908, 1909, and 1910," Bucks County Historical Society Papers 6 (1932), pp. 321-330. Although the concrete work was done in three summers, the interior construction and finishing took an additional year and a half. Mercer moved into Fonthill on May 29, 1912.

¹³Sales/Expense Books, MPTW Records, Series 9, Vol. 1, p. 191, MPSL.

¹⁴Architectural Notebooks, Group 1, Series 3, Vols. 1-5, MPSL.

sources, it does rely heavily upon evidence from Fonthill. It is an assumption, but a safe one, that the Tile Works was built in much the same way as Fonthill.

As at Fonthill, all concrete at the Tile Works was mixed and poured by hand. The Fonthill mixture for columns, floors and walls was one part Portland cement, 2 1/2 parts yellow sand, and 5 parts bluish crushed trap (an igneous rock akin to basalt), just the proportions recommended by a contemporary builder's manual for maximum compressive strength.¹⁶ In texture and appearance, the Tile Works mix is somewhat coarser than Fonthill; the concrete mixture may have been changed at the Tile Works, but if so, the new formula was not recorded. If the stones, bricks, and even bottles which protrude from the walls in various places are any indication, purity of the mix was not a major concern.

Mercer developed his own treatment for the ceilings at Fonthill. "Having heard of serious condensation of moisture in a recently built house in Canada," Mercer explained, "we decided to cast a very porous undercrust on all further ceilings. This consisted of Portland cement 1 part and fine sifted cinder 6 parts."¹⁷ Mercer cast a three-inch layer of this mixture beneath the reinforcing rods in the ceilings and topped this with a five-inch layer of the regular concrete mix. Presumably the same technique was used at the Tile Works, where the ceilings are also of cinder concrete. Because of the irregularity in the forming and casting process, bits of reinforcing metal occasionally peep through the concrete walls and ceilings of the Tile Works. These glimpses are enough to indicate the size and shape of the reinforcement of these elements and to give a rough idea of its placement. However, the size and placement of column and pier reinforcements and the method of fastening intersecting reinforcing rods remain hidden inside the Tile Works walls. At Fonthill, piers and columns are reinforced with hollow 3/4-inch or smaller iron pipes, bought at area junk yards. The vertical reinforcement at the Tile Works may be smaller than this, owing to its need to support only two stories, rather than five or six. Tile Works walls and ceilings are reinforced with round iron rods, one half inch in diameter. The rods are spaced vertically and horizontally at irregular intervals of 16 to 24 inches. Although accepted practice, then and now, is to wire vertical and horizontal rebar together before pouring, at Fonthill, Mercer simply dropped horizontal reinforcements down the forms every two feet or so as the concrete was being poured. It is not known whether all rebar was wired together before pouring at the Tile Works, or whether the Fonthill method was used. Floors, ceilings, and roofs at both buildings were additionally reinforced with galvanized iron farm fencing with a rectangular mesh of 5 inches by 12 inches. This fencing may also have been used in the Tile Works walls, although conclusive physical evidence for it has not been found.

¹⁶Maurice M. Sloan, The Concrete House and Its Construction (Philadelphia: Association of American Portland Cement Manufacturers, 1912), chapt. 4.

¹⁷HCM, "The Building of Fonthill," p. 326.

Mercer's form-work was unorthodox. He used salvaged and rough-cut lumber for his forms.¹⁸ For wall forms, boards were usually laid horizontally edge to edge and nailed together with battens wherever convenient. The forms were kept from bulging by passing wire through the forms, looping it around the battens, and twisting it tight. Bits of batten wire remain imbedded throughout the Tile Works walls. Sheet metal was also sometimes used for forming, possibly for the ease with which it could be bent to shape or for the smooth concrete surface it produced. Again, pieces of the forming material remain attached to the walls here and there in the building.

The factory's barrel-vaults were cast on forms made of planks laid parallel to each other. The groin-vaulted ceilings of the clay pit and first floor were poured on mounded earth forms. Walls and columns were poured in wooden forms up to the spring point of the vault. Several inches below the tops of the columns, a horizontal wooden platform was built. Mercer described these platforms as being very roughly constructed of wooden "rails," covered with a layer of grass to keep the earth from falling through the cracks.¹⁹ Several inches of earth was spread over the grass, then empty boxes and crates were piled up into a very rough, vault-like shape. The crates added volume to the form without adding much weight to the platform. The crates were covered with another layer of earth, which was smoothed into the final vaulted shape. At Fonthill, additional measures were taken to produce evenly curved vaults of a specific height and to cast tiles directly into the ceiling.²⁰ With the exception of Tile Works manager Frank Swain's office, the vaults at the Tile Works are irregular and undecorated.

Mercer drew up no formal plans for the New Pottery, working instead from rough sketches and drawings. He did model a portion of the factory after "Indian House," the studio at his old pottery. The construction notebook for the New Pottery contains sketches of the old works, with dimensions and Mercer's comments, such as "too narrow," "right width," and "should be twice as large."²¹ He translated this information into a single sketch of the first floor plan of the New Pottery, which shows the configuration and basic dimensions of the building and indicates the number of stories and ceiling heights in various parts of the structure.

¹⁸A contemporary manual of concrete construction advised just the opposite. See Sloan, p. 108. Evidently Mercer did not share the industry's customary desire for speed, regularity, and efficiency. Low initial cost and artistic effect appear to have been his primary concerns in choosing concrete forming techniques.

¹⁹HCM, "The Building of Fonthill," p. 326.

²⁰A complete description, with sketches, of Mercer's vault forming technique is located in the Fonthill Construction Notebook, Group 1, Series 3, Vol. 1, pp. 100-102, MPSL.

²¹Tile Works Construction Notebook, Group 1, Series 3, Vol. 2, pp. 1-4, MPSL. The chronology of the construction of the New Pottery is from this notebook.

Work began in March of 1911 on the north end of the building. Foundations for walls and kilns were dug in March and April, and by the end of June, the roof of the clay pit and the first floor walls had been completed, and work had begun on the vaulted ceilings. On June 27 Mercer noted, "Ceiling forms constructed at corner over Frank's room [Frank K. Swain, long-time manager of the MPTW] & began filling. Barrel vaults made of boards, cross vaults of earth." Mercer adapted his methods as he proceeded. On July 12 he wrote, "Find carpet needed over loose earth forms. Find that unsifted cinder casts very porously on ceiling, especially on dry and rough earth forms, but tight on boards where carpet thrown over cracks. Decided to use carpet at all points."

Work on the first floor vaults continued throughout the summer. The entry for July 26 notes that construction of a "glost kiln" (probably glaze kiln No. 1) had begun. By early October all first floor vaults had been completed, and work began on the second story walls. On October 12 Mercer noted the completion of the second story walls in the north corridor and the erection of the roof forms above the glaze kilns. The roof above the kilns was completed several weeks later and carried around the corner onto the east wing of the building. The final notebook entry for 1911 reads "Stopped work on New Pottery Nov. 14, 1911 because of cold. Roof done beyond 2nd large kiln." In the first eight months of construction, the clay pit and the entire first floor were completed, as was the second story on the north and half of the east wings. It is not clear from the construction notebook whether the second story of the west wing was completed in the fall of 1911 or the following spring. Work on the New Pottery resumed about April 1, 1912. By April 12th the east wing, including the Spanish Gable, had been completed. On June 1st Mercer recorded, "Main building done. Gallery [courtyard] balustrade 2/3 done. Doors nearly all made or hung."

With the main structure largely completed, Mercer turned his attention to the showroom of the new factory, which he called "Indian House." Mercer had built the first "Indian House" in 1895 as an archaeological workshop, naming it for the site of one his first cave excavations. In 1897, when Mercer took up ceramics, he converted this building into a pottery studio. Characteristically, Mercer wished to carry this historical reference and inspiration with him, and rather than simply retaining the name, he chose to duplicate the space as well. Drawings and photographs of the original Indian House show a two-story room with a balcony on two sides, a walk-in fireplace opposite, and a large expanse of windows at the gable end.²² Mercer repeated this interior at the New Pottery, substituting a barrel vault for the peaked roof at Aldie and reinforced concrete for the original wooden frame construction.

The walls and roof forms of the new Indian House were built in June and July, and after four days of placing the reinforcement, the first concrete was

²²Several sketches by Wilson Eyre of the interior of Indian House were published in House and Garden 1 (August 1901). Additional photographs of the structure are in the collections of Spruance Library, BCHS.

poured for the roof on August 6th. The last shovelful was patted into place on August 23. By Mercer's reckoning, the roof of Indian House took his crew two months from start to finish.

Mercer's men spent the next two months finishing off the interior of Indian House, hanging a collection of pre-industrial artifacts from its ceiling, moving the machinery over from the old pottery, and constructing a one-story concrete stable just to the north of the pottery. On October 22nd Mercer observed Frank Swain "at his table" in the New Pottery. The first kiln was fired at the New Pottery on October 28, 1912; this was glaze kiln No. 1.²³ Mercer wrote "Building completed" in his notes of November 12, 1912. In the same entry he described dynamiting the first reinforced concrete structure he had ever built, the kiln shed at the old pottery.

Despite Mercer's note and the commencement of tile making at the new pottery, the building was not, in fact, completed. The two story tower above the east end of Indian House and the bird roost on its west gable were added in the summer of 1916.²⁴ It is not clear whether Mercer intended to construct these from the outset or whether they were a later modification, designed to add interest and distinction to the building's exterior. The construction notebook of 1911-1912 contains sketches of towers similar to the one that was built, but the reason for the four year delay remains unknown.

Stylistically, the Moravian Pottery and Tile Works is a composite of buildings and features Mercer had encountered throughout his career. Indian House, of course, provided the model for the studio interior at the New Pottery. The exterior was inspired by the Spanish mission architecture of Southern California. Although Mercer is not known to have visited California, the Tile Works construction notebook contains sketches of architectural details from the missions of San Juan Capistrano, San Luis Rey, San Fernando, San Diego, San Miguel, and several others. Other details, such as the front entrance, closely resemble sketches of the local architecture Mercer made during his archaeological expedition to the Yucatan peninsula in 1895.²⁵ As in all of his buildings, Mercer combined historical references with modern materials and novel techniques to produce structures which are evocative of the past, but uniquely his own. The roof tiles at the Moravian Pottery and Tile Works exemplify Mercer's anachronistic combination of past and present. Although authentic in appearance and architecturally appropriate, they are purely decorative; rain is repelled by the waterproof concrete below.

²³Kiln Records, MPTW Records, Series 6, Vol. 1, p. 127, MPSL.

²⁴Sales/Expenses, MPTW Records, Series 9, Vol. 1, p. 76, MPSL.

²⁵Yucatan Sketch Book, MPSL.

past and present. Although authentic in appearance and architecturally appropriate, they are purely decorative; rain is repelled by the waterproof concrete below.

Kiln Design

The heart of tile manufacture at the Moravian Pottery and Tile Works is the kilns. Indeed, their tall, decorated chimneys are one of the most striking architectural, as well as technological, features of the Moravian Pottery and Tile Works. Although Mercer imported their original design from European potteries, he apparently modified it somewhat during his ownership of the pottery. Despite Mercer's brief apprenticeship in local Pennsylvania German potteries, the initial design for the Moravian Pottery and Tile Works kilns probably derived from contemporary English industrial practice. The bottle shape of the Tile Works kilns resembles that of European updraft kilns developed in the seventeenth and eighteenth centuries.²⁶ In eighteenth- and nineteenth-century England, the dominant kiln form was the "hovel kiln," whose firing chamber was inside but structurally unconnected to the surrounding, bottle-shaped brick enclosure or "hovel." Downdraft kilns, used primarily for brick and quarry tile, existed at the same time, but were beehive rather than bottle shaped.²⁷ In the early twentieth century, downdraft bottle kilns which closely resemble the Moravian Pottery and Tile Works kilns were introduced in England in an effort to improve fuel efficiency.²⁸ Unlike these kilns, however, the Moravian Pottery and Tile Works kilns are "double-draft", capable of firing in either updraft or downdraft modes. Although no direct link has been established, the Moravian Pottery and Tile Works design may have been inspired by the "Minton's Oven," patented in England in 1873, which has a downdraft lower chamber for firing glazed ware and an updraft upper chamber for biscuit ware.²⁹

Whatever its exact technical roots, Mercer himself noted the English origins of his kiln design. "On January 28, 1899, John Briddes, an English potter, offered his services and began work by superintending the construction of the first kiln [at the old pottery], which was built by Herman Sell and completed by February 28,

²⁶A good, historically grounded study of kiln design has yet to be written. The following discussion is based upon these standard, but historically vague, design studies: Daniel Rhodes, Kilns: Design, Construction, and Operation (Radnor, Pa.: Chilton Book Co., 1968), 40-43. David Sekers, The Potteries (Aylesbury: Shire Publications Ltd., 1981), pp. 15-17.

²⁷Sekers, p. 17; Rhodes, pp. 47-52.

²⁸Sekers, p. 17; Bottle Ovens (Longton, Stoke-on-Trent: Gladstone Pottery Museum, 1984).

²⁹Rhodes, pp. 51-52.

a moment's notice."³¹

Briddes was a kiln builder who had emigrated to Philadelphia about 1896. He supplied the design and supervised construction, but the actual building was done by Herman Sell, a local mason. Briddes spent several months in Doylestown in 1899 to instruct Mercer's crew in the kiln's operation and advise on production matters. Little else is known about him, except that he supplied the formula for one of the Moravian Pottery and Tile Works's clear glazes, called "Briddes No. 10."³²

Although he initially sought outside expertise, Mercer took a keen interest in kiln design, and continued to educate himself. In January 1900, Webster King Wetherill, a Philadelphia white lead manufacturer, wrote to Mercer describing the workings of the downdraft kilns at the Richard C. Remmey & Son ceramic factory in Philadelphia. Although fragmentary, the letter contains detailed firing instructions and a sketch of a two-chamber, bottle-shaped kiln similar to those at the Tile Works. Wetherill's comment that he had used Mercer's sketch to initiate his discussion with Mr. Remmey makes clear that he was on an errand for Mercer.³³ Mercer's reply has unfortunately been lost, but a subsequent letter from Wetherill, clarifying his earlier description, notes "your drawing 'F' is correct. The regulator orifice is just as you have shown it."³⁴ Evidently Mercer's was a detailed, not a general, interest.

It is difficult to draw conclusions without more detailed information on the interiors of the kilns at the Old Pottery (which have been destroyed), but a general continuity in design seems likely. Herman Sell, who worked under Briddes on the first kiln and did not come from a ceramics background himself, built all the remaining kilns for Mercer.³⁵ Still, photographs do reveal some changes. Despite a basic similarity in shape and proportion, the ash pits of the New Pottery kilns are at, rather than below, ground level, and their fireboxes have a different configuration. To what extent these changes are the result of Mercer's own research is unknown.

The most substantive change in kiln design at the Moravian Pottery and Tile Works appears to have been the addition of a central chimney through the firing

³¹In 1916 at Mercer's request, Frank Swain compiled a four page memoir of the Pottery's early years, for use in Mercer's "Notes on the Moravian Pottery." Manuscript Notes, FM 19:4, MPSL.

³²On Briddes's influence, see Cleota Reed, Henry Chapman Mercer and the Moravian Pottery and Tile Works (Philadelphia: University of Pennsylvania Press, 1987), p. 45.

³³Webster King Wetherill to HCM, 20 January, 1900, MPSL.

³⁴Webster King Wetherill to HCM, 29 January, 1900, MPSL.

³⁵HCM, "Notes," p. 487.

chambers of the two large biscuit kilns at the New Pottery. The central chimneys substantially alter the interior air flow and operation of the kilns and increase control over firing conditions. (The operation of the kilns is described more fully below.) Without knowing the interior details of the earlier kilns, interpretation is somewhat speculative, but these chimneys probably do not pre-date 1914. They are not present in the three smaller glaze kilns at the New Pottery, which are most like Briddes's original design, nor do they appear to be constructed of the same fabric as the rest of the kiln.

Moreover, under the heading "Improvements" in the 1914-15 Annual Report, Frank Swain noted, "Practically no loss in burning large kilns with central flue."³⁶ The term "improvement" in previous reports usually refers to physical improvements, and the only physical improvement this note seems to indicate is the addition of the flues. It is unlikely that Swain would have made this comment at all if the biscuit kilns were the same as they had been since 1912. While Mercer's influence in the design change cannot be demonstrated directly, it is likely he instigated the improvement given his intense interest in the technical processes employed at the Moravian Pottery and Tile Works.

Utilities

Heat

When the factory was built it had no insulation and no central heating system. Several cast iron, coal burning stoves were scattered through the building at key locations, but most heat in the production areas was supplied by the ongoing operation of the kilns and boiler. Particularly in winter, production clustered in the workspaces surrounding the kilns. Indian House, the showroom, was heated by both a walk-in fireplace and by a brick and tile Russian stove located on the south side of the room. There was no heat at all in the west wing, which served as storage for production molds and finished tiles.

When the factory reopened as a museum in 1969, with no kilns operating and offices and a shop added to the west wing, the need for additional heating became obvious. Since then, a variety of heaters have been installed in the building. In the west wing, the first floor and the southern two rooms of the second are heated electrically. In the east wing, the ground floor is heated with gas and electric heaters, and the southernmost room of the second floor is heated electrically. The north wing, where the glaze kilns are located, remains unheated, though the original coal stoves remain in situ.

At one point, a large electric heater was hung from the ceiling of the showroom, but was both ineffective and unsightly. In 1987, an oil-fired, forced air heater was installed in a small room below Indian House. This room may originally

³⁶Sales/Expenses, MPTW Records, Series 9, Vol. 2, p. 49, MPSL.

have been a darkroom used for the factory's photographic needs.³⁷ A heat vent was cut in the studio floor at the bottom of the stairs, and a return air duct was cut into the wall underneath the stairs. A sump pump was installed in the basement room to protect the heater from flooding.

Water

Water for mixing clay and other uses came from an artesian well located in the northeast corner of the factory, in a small room just off the clay mixing room. The well was capped with a pump operated by a Model T Ford gasoline engine, which pumped the water into a concrete cistern located almost directly above it, in the east wing tower. From here, water was piped by gravity to the boiler and several sinks on the first and second floors. There was no interior plumbing; waste water from the sinks was emptied directly through the walls of the factory and onto the ground outside.

In 1929, John J. Rufe and Sons installed a new pump, and at some point thereafter, an electric motor was added to it.³⁸ The pump and artesian well continued to be used until about 1979, when the well went dry. At that time the factory was connected to the township water system and plumbing was run to three locations in the east wing. The cistern is no longer used.

For the factory's conversion to a museum in 1969, the stable just north of the factory was converted into a public rest room, hooked up to the township water and sewage systems. A modern bathroom was installed in the southernmost end of the west wing, probably at the same time. It is unknown whether the factory contained toilet facilities prior to that time, but if so, they were probably located in the same spot.

Electricity

Electrical power was not included in the original construction of the New Pottery. The boiler and steam engine provided power for the clay mixers, and virtually all other manufacturing processes were done manually. Nor was electricity essential for lighting. One of Mercer's great skills as an architect was his integration of natural light into interior spaces. All the rooms in the pottery, except the clay pit, have outside windows on at least two sides. Additional light for loading kilns and evening work was provided by lanterns of different sorts.³⁹

Electricity was finally installed in the factory in 1954, after Frank Swain's

³⁷Reed, p. 56.

³⁸Uncataloged Receipts, 1929, MPTW Records, MPSL.

³⁹Benjamin H. Barnes, The Moravian Pottery: Memories of Forty-Six Years (Doylestown: Bucks County Historical Society, 1970), p. 24.

death, and at least one electric kiln was installed in the late 1950s or early 1960s.⁴⁰ More electrical lines and some light fixtures were installed in 1969. The wiring was run in copper conduit mounted on the concrete walls. Since then, as the site has developed, additional lines have been run in standard steel conduit to supply power for lights, heaters, appliances, and kilns. In 1985, because of heavy use, three-phase electrical service was installed. The main electrical panel is located against the south wall of the east wing, in the present kiln room.

Alterations to the Structure

Because of its cast construction and relatively consistent manufacturing use and technology, there have been few major structural changes or alterations to the factory. The most visible exterior change has been the removal of a one story wooden shed that originally spanned the open end of the factory's courtyard, creating an enclosed space entered by a single gate, reminiscent of a traditional English potbank. This shed originally housed barrels and other shipping accessories, and was removed at some unknown time, probably after Mercer's death. Since Bucks County has owned the property, however, a number of alterations have been made, both to maintain the structure and to make it function more suitably as a public museum.⁴¹

Shortly after the County took possession of the site, it sought to make the building suitable for visitors. It converted the adjacent stable into toilets, installed the present parking lot, poured a new concrete path to the front door, and upgraded the electricity and lighting. It also performed other maintenance and repairs, including reglazing some windows and installing blue fiberglass panes in the large gable-end window of Indian House. About 1971 a concrete slab was poured over the existing dirt floor in a small area at the south end of the west wing. The same thing was done to the dirt floor in the east wing south of the biscuit kilns about 1975.

In 1976, after the decision had been made to resume production and to hire summer interns, part of the east wing's second floor was converted into an apprentice studio. A concrete stairway was installed in the hole originally left between floors for the possible addition of another biscuit kiln. Work tables were installed upstairs, along with a sink, lights, and electric heaters. A skylight was installed above the stairs, in the roof opening left for the prospective chimney.

In 1981, major repairs were made to the factory's roof and decorated chimneys. Perhaps because the building was constructed without expansion joints, the roof developed numerous leaks over the years. Photographs show it

⁴⁰Barnes, p. 25.

⁴¹The following summary is based upon a series of interviews with County maintenance personnel and the site manager, Charles Yeske, in the summer of 1987.

had been extensively patched with tar. In 1981 the entire concrete roof of the factory was recoated with gunite, a sprayed on cement finish which effectively sealed almost all the leaks. As part of the same project, the chimneys for the kilns and boiler were rebuilt. These, too, were in bad shape. With the exception of glaze kiln No. 1, all chimneys were kept as close as possible to their original appearances, with reproduction tiles replacing broken or missing ones. Because no active use was planned for most of the chimneys, alterations were made to their interiors to increase their structural integrity.

About one third of the chimney of glaze kiln No. 1 was taken down and rebuilt, and the rest was repointed. It was rebuilt with a soft mortar and was not re-tiled, in anticipation of a future rebuilding of the entire kiln. The chimney of glaze kiln No. 2 was taken down, rebuilt entirely, and re-tiled with a combination of original and reproduction tiles. The chimney of glaze kiln No. 3 was lined with a sheet metal sleeve set in cement and repointed on the outside. The boiler chimney was repointed below the factory roof and was also lined to add structural integrity. The chimney of biscuit kiln No. 1 was rebuilt entirely with an added terra cotta liner, and biscuit kiln No. 2 received a concrete liner.

The resurfacing of deteriorating concrete surfaces was continued in 1985. In that year the columns and walls of the courtyard arcade were repaired with gunite, along with several other spots on the courtyard balcony and around the eaves of the building. At the same time, the concrete walkway beneath the courtyard arcade was replaced and lowered three to four inches on average. This was done for two reasons. First, the concrete drainage trough attached to the walkway had deteriorated and needed replacing. The trough, which was filled with gravel, runs along the outside edge of the arcade slab and drains water downhill through three conduits under the north wing of the factory. Since some demolition was necessary to replace the drainage trough, it was deemed desirable to level out the walkway at the same time, in the interest of visitor safety. The original walkway was quite uneven, with frequent bumps and dips and cut-outs to allow clearance for outwardly opening doors. The new concrete walkway is lower and flatter. Other minor alterations to the Moravian Pottery and Tile Works's structure are mentioned elsewhere in this report.

Tile Manufacture

The Moravian Pottery was established in 1898 for the making by hand of tiles used in the decoration of pavements and walls. From then until now, 1929, it has successfully maintained against all modern conditions of mass production and financial gain its principle that such tiles have been and should be works of art, and that a work of art never can be made by machinery.

Henry Chapman Mercer⁴²

⁴²HCM for the Washington, D.C. Chapter of the Daughters of the American Revolution, MPSL.

Henry Mercer's relationship to the technology of tile manufacture was complex and ambiguous. Originally based upon the preindustrial craft processes of the Pennsylvania German potter, the business soon began to express an explicit Arts and Crafts ideology which rejected the use of machines. In practice, however, the Moravian Pottery and Tile Works diverged in several important respects from Arts and Crafts ideals. The factory, for example, processed its clay with steam-powered mixing equipment and used a variety of presses, jigs, and molds throughout the process. Nor did Mercer subscribe to the idealized vision of the independent designer/craftsman who personally controlled his work from idea to completion. Mercer reserved virtually all of the factory's design work for himself, leaving the execution to his employees. Different employees were generally responsible for different stages in the production, and in the case of quarry tiles, a quota for the workers' daily output was set.

In explaining his philosophy, Mercer repeatedly insisted upon the incompatibility of "machines" and "art." Yet, as David Pye has lucidly argued, a hand versus machine split is a false dichotomy. The primary aesthetic issue for members of the Arts and Crafts movement was not motive force (as Mercer himself demonstrated in his use of steam power), but control of that force. The regular, identical ceramics to which Mercer objected were produced by what Pye calls the "workmanship of certainty:" strictly controlled motions whose outcome, whether powered by hand or machine, is certain. In contrast, a "workmanship of risk," employing production techniques in which errors can occur, yielded the varied and diverse wares Mercer prized.⁴³

As a businessman in an era of mechanization and mass production, Mercer knew he had to control his costs and manage his enterprise efficiently. "My first effort therefore was," he wrote, "to invent new methods of producing hand made tiles cheap enough to sell and artistic enough to rival the old ones."⁴⁴ Commercial considerations led Mercer to adopt methods using workmanship of certainty in processes such as clay mixing and slab rolling the results of which are not visible in the final tiles. In steps affecting their final appearance, however, Mercer employed workmanship of risk. Most of the techniques that determined the final appearance of Moravian tiles, including pressing, glazing, and firing, were obsolete by the time the factory was founded.⁴⁵

As a public museum interpreting the history and operation of Henry Mercer's tile factory, the Moravian Pottery and Tile Works currently manufactures tiles in

⁴³David Pye, The Nature and Art of Workmanship (Cambridge: Cambridge University Press, 1968).

⁴⁴HCM to William Hagerman Graves, 14 November 1925, MPSL.

⁴⁵Josiah Wedgwood made tremendous progress in standardizing the manufacture of ceramics in the second half of the eighteenth century. An informative summary of these efforts appears in Adrian Forty, Objects of Desire: Design and Society from Wedgwood to IBM (New York: Pantheon Books, 1986).

much the same way as it did in Mercer's time. Some concessions have been made to improve health and safety conditions and to operate the factory more efficiently, but the production process is largely what it was when the new pottery opened in 1912. Most of the surviving machinery predates the New Pottery, having been purchased about ten years earlier for use at the first Moravian Pottery and Tile Works. It was moved to its present location in September and October of 1912.

Clay Mixing

The first step in manufacturing tile is the preparation of the clay. Mercer chose to use untempered native clay, as it was dug from the ground. This decision forced him early on to abandon his initial desire to reproduce traditional redware vessels. The local red clay contains a high proportion of silt and is quite "short," cracking easily when formed into curved shapes. This characteristic, while undesirable for pottery, is actually beneficial for making tiles, as it greatly reduces warping and shrinkage. In order to make best use of the local materials, Mercer chose early on to emphasize tile manufacture at his pottery and tile works, and the few vessels that he manufactured were slab-molded rather than thrown.

Mercer was adamant that plastic clay must be used. In 1925, Mercer commented that "the Prosser's semi-dry-dust process then, 1895, in vogue, was fatal to the beauty of tiles."⁴⁶ He was referring to the technique, pioneered in England by Richard Prosser in 1840, of producing ware by pressing slightly moist powdered clay between two metal dies under considerable pressure. This technique was admirably suited to the mass production of tiles; it eliminated many of the problems of shrinking and warping, and reduced drying time substantially. Much to Mercer's disgust, it also produced absolutely identical tiles which he considered oppressively mechanical in surface and texture.

One of the few clearly defined production spaces at the Moravian Pottery and Tile Works is the clay mixing room in the northeast corner of the factory's ground floor. The local red clay is first processed to a proper working consistency in a "Mascot" Auger Machine, purchased from the American Clay Machinery Co. of Bucyrus, Ohio in 1903. A circa 1908 trade catalog, which lists the company's "Pug Mills" separately from its "Auger Brick Machinery", indicates that this machine did double duty at the Tile Works.⁴⁷ According to the catalog, pug mills were designed for combining different ingredients and incorporating water into dry clay. They usually were designed with long, open troughs for mixing different types of clays or grogs, and could hold the clay until it was thoroughly mixed. Augers, on the other hand, were intended primarily for extruding, and were supposed to be fed with clay that was already moist and plastic.

⁴⁶HCM to William Hagerman Graves, 14 November 1925, MPSL.

⁴⁷The auger was purchased on Aug. 31, 1903 for a cost of \$325. See Uncataloged Receipts, 1903, MPTW Records, MPSL. The machinery is described in the American Clay Machinery Co.'s Catalog Number Eighty, a circa 1908 trade catalog in the collection of the Hagley Museum and Library, Greenville, Delaware.

The Mascot auger at the Tile Works serves as both pug mill and auger. Raw clay is shoveled into the machine from wheel barrows, and water is added with a hose. The auger mixes the clay and water and expels it through a screen attached to the front of the auger, which removes the larger rocks and twigs from the clay. After it has been screened, the clay, now pliable, is run through the machine again, this time through an 11-inch by 4-inch rectangular die.

The clay is extruded onto a "No. 1 Combination Cutting Table," also manufactured by the American Clay Machinery Co. and purchased in 1903. The cutting table is set at the height of the die and consists of a bed of rollers and a pivoting frame strung with wires. When the extruded clay has filled the bed, a worker lifts the frame, cutting the clay into blocks about 12 inches square. The worker then stacks two blocks together, puts them in a plastic bag, and loads them onto the adjacent dumb waiter. The dumb waiter has a counterweight slightly less heavy than a standard package of clay. The weight of the clay carries it automatically down into the clay pit below, and when the clay is unloaded, the counterweight falls, returning the dumbwaiter to the clay mixing room above. The only modern additions to this process have been the use of hoses to add water to the raw clay and plastic bags for storage. During the heyday of the Moravian Pottery and Tile Works, workers may have kept the clay moist by covering it with a damp tarpaulin.

Close by the auger is a 12-inch vertical pug mill purchased from the Crossley Manufacturing Co. of Trenton, New Jersey in 1902.⁴⁸ It was probably used to process red clay before the larger auger was acquired. Although it is not presently in use, layers of built-up clay uncovered in a recent overhaul indicate that it was used at the new pottery to mix colored clay bodies; this was done by adding pigments to buff clay. The pug mill is situated to be operated by pulley from a line shaft running along the eastern wall of the clay mixing room. The pug mill may originally have been operated by a horse. According to a 1916 account written by Frank Swain, prior to the purchase of "the large steam clay grinder" in 1903, all clay had been mixed by horse power.⁴⁹

By 1903, both clay mixers were powered by steam. In January of that year, the Moravian Pottery and Tile Works purchased a 15 h.p. horizontal steam engine, a "Metropolitan" side-crank, self-contained model manufactured by Donegan and Swift of New York.⁵⁰ A 20 h.p. vertical boiler accompanied it. Both boiler and

⁴⁸Uncataloged Receipts, 1902, MPTW Records, MPSL.

⁴⁹Swain, Manuscript Notes, FM 19:4, MPSL.

⁵⁰Uncataloged Receipts, 1903, MPTW Records, MPSL. The engine is described in N. Hawkins, New Catechism of the Steam Engine (New York: Theo. Audel and Co., 1904), pp. 142-144.

engine were moved to the new pottery in 1912. The steam engine, though not presently in use, survives in good shape. The original boiler was replaced in 1929 with a 20 h.p. Orr and Sembower vertical boiler, which is also intact. The boiler was inspected in 1975, and both boiler and steam engine were briefly operated on an experimental basis. However, given the complexity and expense involved in operating and maintaining a steam power system, Bucks County chose to convert to electric power. The auger is presently operated by a 15 h.p. gear head motor installed in 1980. The County is currently drawing up specifications for making new blade patterns, casting new blades, and overhauling the machine. The work is slated for completion in 1990.

Tile Making

Because of its manual nature, most of the work of cutting, shaping, and applying glaze to the tiles could have been moved from place to place within the building as the need arose. Aside from the kilns and clay mixers, the workspace inside the factory was flexible and often multipurpose. Tilemaking is now done almost entirely on the ground floor of the north and east wings. After the clay is mixed it can be made into either quarry, decorative, and mosaic tiles, each of which uses a somewhat different process.

Quarry Tiles

Quarry tiles are flat, geometric shapes used primarily for paving floors. They are cut from slabs of clay using cutters made of wood and sheet metal which operate much like cookie cutters. The sheet metal cutting edges are soldered into the pattern to be cut and mounted within a wooden frame with handles on the sides. A system of wooden plungers fits down inside the sheet metal tubes. To cut tiles, a worker presses the cutter into the slab of clay, lifts it over to a nearby ware board, and presses the plungers, which expel the cut tiles onto the board. The tiles are then dried, glazed if desired, and fired.

Quarry tiles are presently made in the room just south of the clay mixing area, between the two large biscuit kilns. Slabs of clay for quarry tile cutting are prepared on a portable slab roller acquired in the mid-1970s. The slab roller is operated by human power, and though not authentic, it closely mimics the original production method while increasing speed and efficiency. In Mercer's day, slabs were made by cutting a long, thin horizontal slice from the clay extruded by the auger, and placing this on a rolling board. The rolling boards were long boards about thirteen inches wide with half-inch cleats attached along the sides. Using a roller, workmen would flatten the clay into the board and roll it smooth, producing uniform slabs one half inch thick and twelve inches wide.

Decorative Tiles

Decorative tiles are made individually by pressing plastic clay into plaster molds. Plaster is used because it absorbs moisture from the clay, causing it to shrink slightly and release from the mold. The two basic types of tile molds are

press molds and stamp molds. With stamp molds, a design is pressed into the surface of a piece of clay, and the thickness of the tile is determined by the amount of pressure the workman applies. With press molds, the depth of the tile is determined by the mold; the clay is pressed into the cavity of the mold and trimmed off flush with its back. Highly sculptured tiles in high relief can be produced with press molds.

In his "Notes on the Moravian Pottery of Doylestown," Mercer recalls that in 1899 "several presses were devised" to force clay into the plaster molds.⁵¹ One of these obviously home-made devices survives at the Moravian Pottery and Tile Works. It was used experimentally in 1975, and resulted in an unacceptably high rate of mold breakage. Instead of using the original press, the director of the re-activation study, Wayne Bates, decided to have two hand presses of a modern design manufactured for the Moravian Pottery and Tile Works. These are still in use and are located in the northeast corner of the factory, just south of the clay auger.

The Tile Works collection contains approximately 5,000 plaster tile molds, which are currently being inventoried and researched. Further information will no doubt be forthcoming, but sufficient evidence has been gleaned to draw several conclusions. While press molds remained essentially unchanged, the design of stamp molds changed over time, indicating an evolution of moldmaking and production processes.

The first series of tiles Mercer introduced, the 5 1/2 by 7 inch Stove Plate series of 1898, is represented in the collections by plaster stamp molds cast into rectangular iron casings about 1 1/2 inches deep. Because no other designs were produced by metal-cased molds, these are assumed to be the earliest type of mold used at the tile works, and because these molds fit into the surviving historical press, the press most likely dates from the turn of the century. David Malken, Director of the Gladstone Pottery Museum in Stoke-on-Trent, England, has suggested that these iron molds were copied from the molds used in industrial steam presses of the period.⁵² This would suggest that Mercer employed them while he was still educating himself in the manufacture of tile. The lack of any subsequent designs employing this mold technique indicate that the stresses involved in hand production did not warrant the expense and difficulty of metal cases.

Instead, the factory developed a system of casting production stamp molds on blocks of wood. Tacks pounded into the face of wooden blocks were then imbedded in wet plaster as the molds were cast. This technique bonded a durable support to the brittle plaster molds. The Moravian Pottery and Tile Works has

⁵¹HCM, "Notes," p. 484.

⁵²Personal interview with David Malkin on his visit to the MPTW, 5 October 1987.

examples of the 5 1/2 by 7 inch Stove Plate series mounted on wood, suggesting that this technique was adopted fairly soon after the experiment with the iron casings.

Mounting stamp molds on wooden blocks became standard practice, but the tile press was soon abandoned. The surviving turn of the century press handles only 5 1/2 by 7 inch molds, and would not have worked well on the various sized tiles the factory began to produce. In addition, most of the backing blocks of the production molds show considerable wear from having been hammered into the clay. Pounding wooden-backed molds into clay slabs with a mallet was evidently just as effective as the press, and would have eliminated the cumbersome process of loading and unloading the press for each tile. The great majority of stamp molds in the collection have wooden backs.

In addition to the press molds and metal-cased and wooden-backed stamp molds, a few examples of a fourth type of production mold survive. These molds are a hybrid of quarry tile and decorative tile techniques. They consist of a hexagonal sheet metal tube into which fits a wooden-backed plaster mold affixed to a wooden rod. The metal tube cut the tile from a slab of clay, and the plunger impressed a decorative pattern onto the tile as it was expelled onto the wareboard. It is doubtful that this technique was successful. The Moravian Pottery and Tile Works has several hexagonal molds which have had the rods removed and which have extensive wear on the wooden backs, indicating that they were dismantled and used as ordinary hammered stamp molds. The collection also contains molds of the same images which were made as regular wooden-backed molds, with no evidence of attached dowels.

Other molds in the collection are less comprehensible than these. There are a small number of wooden-backed molds which have different sizes of wooden cleats and shims nailed to the rear. These shims do not provide a broad, flat surface suitable for pounding, but rather seem intended to make the backing blocks -- which, judging from their widely differing shapes and sizes, were made of scrap wood -- a consistent size. This in turn suggests the existence of another tile press of some type, which is currently unknown.

Mosaics and Relief Brocades

In addition to quarry and individual decorative tiles, the Moravian Pottery and Tile Works produced several types of multi-piece pictures in tile. The first type Mercer developed were called "mosaics." Unlike traditional mosaics, which were composed of variously colored square stones or glass tesserae, Mercer's mosaics resemble stained-glass windows. Mercer's images are defined by the grout lines or joints in the mosaic, while tiles of various finishes constitute fields of color between the lines.

In 1904 Mercer patented both this technique of assembling tile pictures and

the type of mold used to make them.⁵³ Benjamin Barnes, who was foreman and manager of the Moravian Pottery and Tile Works from 1910 to 1956, described the process as follows:

A tile-thick slab was cut by slicing a bat of moist clay with a wire that had a traverse hand-grip at either end. The drawing was laid on this slab and traced off with a wooden stylus. After that the paper was removed and the traced lines deepened by pressing with a small squared stick of plaster of paris, the working end of which had been cut wedge-shaped. From this clay original a plaster mould was cast, the deepened lines appearing as ridges on its face. When the mould was to be used, a tile-thick slab of clay was placed on it and pressed. When partly dry or "leather hard" it was removed and the sections cut apart along the lines left by the ridges. The separate pieces were fired, painted with a glaze of the desired color and fired again.⁵⁴

The largest and best known installation of Mercer's mosaic tiles is the lobby of the Pennsylvania State Capitol in Harrisburg. The 16,000 square foot floor contains over 400 mosaics illustrating the flora, fauna, history and industry of the Commonwealth.⁵⁵

By 1908, Mercer had developed what he called "brocade" tiles, the name apparently derived from their resemblance to intricate, textured textile decorations. These high-relief, sculpted tiles were originally developed as a means of decorating the curved surfaces of vaults and arches. Mercer perfected them in building his home, Fonthill.⁵⁶ Unlike mosaic, decorative, or quarry tiles, Mercer's relief brocade tiles were individual pictorial images, intended to be set into a cement background. They are manufactured in standard press molds. The best known of Mercer's brocade tiles are his New World series, his Bible in Tile series, and his Picture Fireplaces.

Art Pottery

In addition to its better known tile, the Moravian Pottery and Tile Works also produced a limited amount of art pottery and three-dimensional

⁵³Mercer received U.S. Patent 733,668 (14 July 1903) for the concept of the tile picture and U.S. Patent 763,064 (21 June 1904) for the mold-making technique.

⁵⁴Barnes, "Memories of Forty-Six Years", p. 7.

⁵⁵For a full description of the floor and its imagery, see HCM, Guidebook to the Tiled Pavement in the Capitol of Pennsylvania (Harrisburg, 1908). Mercer was one of the few suppliers to the State Capitol building who was not charged with defrauding the taxpayers of Pennsylvania.

⁵⁶For a full discussion of the development of the brocade tile technique, see Reed, chapt. 8.

ware.⁵⁷ Most of the pottery forms were derived from Native and colonial American sources, along with a few copies of European pieces. The art pottery frequently duplicated designs used in the factory's tile. Because Mercer's clay was not amenable to throwing, virtually all his three-dimensional ware duplicated his tile making techniques as well. The walls of the inkwells, for example, were slab-built of four tiles joined at the edges. Other pieces were pressed in multiple-piece plaster molds. An examination of surviving molds in the factory's collection indicates some unorthodox mold-making techniques; in some cases it is difficult to see how a piece could be removed from the mold intact. Perhaps these molds are early experiments; if not, they may help explain the relatively minor role the art pottery played in the factory's overall production.

In addition to household decorative pieces like bowls, cups, sconces, and candleholders, the Moravian Pottery and Tile Works produced a limited quantity of large ceramic reliefs for architectural use. These pieces, oversized variants of his brocade tile technique, were made in plaster molds three or more feet long and approximately eight inches deep. The backs of the figures would have remained hollow so that the clay would dry thoroughly before firing. These large architectural pieces most often depicted figures engaged in pre-industrial crafts, and were installed primarily on the exteriors of public vocational schools.⁵⁸

Drying

To prevent trapped moisture in the clay from exploding in the kilns, the tiles must be thoroughly dried before firing. Tiles are currently air-dried on wooden ware-boards, stacked on dollies so that they can be moved around the building and courtyard with minimal handling. Depending upon temperature and humidity, it takes from one to three weeks for the tiles to dry. Evidently, tiles were often air-dried during Mercer's lifetime as well. Benjamin Barnes recalled that "In summer the unfired tiles were set in the sun to dry. In wintertime they were put around stoves, all in metal trays or racks. (We had discontinued the use of wooden racks after the fire at the old pottery which had started when hot coals from a stove ignited them.)"⁵⁹ However often tiles may have been air-dried, mechanical means of drying the tiles were also available. In his Sales/Expense summary for December 1912, early in the operation of the New Pottery, Frank Swain noted "Warner Fry furnished New Hot Air Heater for Drying

⁵⁷Reed, pp. 225-229.

⁵⁸Reed, pp. 161-162.

⁵⁹Barnes, p. 7. Frank Swain's annual report for the fiscal year 1911-1912 notes "A Fire at upper Pottery, Evening March 27-[19]12 destroyed 1200 racks of wood & 48 to 58 Thousand Tiles - Loss about \$1500.00." Sales/Expenses, MPTW Records, Series 9, Vol. 1, p. 221, MPSL.

Room."⁶⁰ The type and location of this heater are unknown, but it was apparently unsuccessful. The annual Sales/Expense summary for 1913-1914 notes the addition of "Steam Heat in Drying Room."⁶¹ The center room on the second floor of the east wing was the drying room. Its east and west walls were originally lined with steam pipes connected to the boiler located on the floor below. The steam pipes were removed about 1977.

How the actual drying was managed is unknown. Speed is desirable from an efficiency standpoint, but too rapid drying can cause cracking and warping. Whether the steam-heated drying room was used routinely or seasonally, for all tiles or just certain types, remains unknown. Also unknown are details such as how close the tiles were placed to the pipes, how long the tiles were dried before firing, and what, if any, effect the two adjacent biscuit kilns had on the drying. Another interesting if small question is the efficiency of the metal racks. Wood, being absorbent, will release the clay as it dries and shrinks; metal will not necessarily do so. In addition to the metal racks mentioned by Barnes, the Moravian Pottery and Tile Works has many wooden wareboards in its collections. Either these date from before the switch to metal drying racks, or the factory resumed their use after experimenting with metal racks for a while.

Glazing

The Moravian Pottery and Tile Works offered tiles in a variety of finishes: unglazed, glazed or "enameled," slipped, smoked, underglazed, or a combination of these. Although Mercer had established his basic repertoire of glaze techniques and formulae in his first several years of experimenting at the old Indian House, he did add and remove finishes from his catalogs over time. The first Moravian Pottery and Tile Works catalog (1901) offered 39 possible finishes; by 1912, Mercer had added 24 finishes and dropped six, leaving customers a choice of 57 possible finishes. This figure is somewhat misleading, however, considering that it was produced by combining a very limited number of materials and techniques in a variety of ways.

Although the application techniques and recipes for all 57 Moravian Pottery and Tile Works finishes have not yet been identified, recent research has established the basic glazing system used at the Tile Works. The following summary is based upon several sources. The Fonthill Museum has in its collection a group of cigar boxes containing sample tiles with glaze formulae and application techniques written on the lids.

⁶⁰Sales/Expenses, MPTW Records, Series 9, Vol. 1, p. 237, MPSL.

⁶¹Sales/Expenses, MPTW Records, Series 9, Vol. 2, p. 29, MPSL.

Although the set is incomplete, it shows the system of combinations and permutations used to achieve such a variety of finishes. In addition, the Tile Works records contain several useful sources. Mercer's "Indian House Notebook" contains notes of his early experiments in establishing his formulae and techniques, and the factory's Glaze Book contains numerous glaze recipes.⁶² Most of these were never used, but a handful have been annotated repeatedly over the years as suppliers and ingredients have varied. Finally, Mercer's account books contain bills and receipts from suppliers, which record what was being purchased where.

The simplest finish used at the factory was no finish at all. The vast majority of quarry tiles produced at the factory were the unglazed brick red of the native Bucks Co. clay. The factory also purchased several white clays from commercial suppliers. A buff-burning clay was purchased from H. C. Perrine of South Amboy, New Jersey, and two white clays, Tuckahoe and Page, were acquired from suppliers in Philadelphia. The Perrine and Tuckahoe clays were used unaltered to produce buff and white decorative and quarry tile, and all three commercial clays were mixed with pigments to produce a variety of colored clays and slips. Colored clay-bodies were mixed to Moravian Pottery and Tile Works specifications in the 1902 Crossley vertical pug mill. Colored-bodied clays were most often used as quarry tile and mosaics in floors, to add color in areas where glazed surfaces could be worn away. Colored clays were generally either single fired or smoked; they were not used with additional applied colorings.

Smoking, which Mercer called "staining," was a second technique of finishing tiles which did not involve applied colorants. This technique consisted of packing dry, unfired ware into saggars with a mixture of sawdust and coal dust. This oxygen-reduction firing not only trapped unburned carbon in the tile, but also removed an oxygen molecule from the iron oxides in the clay, producing an iron compound that is black rather than the more familiar red. This technique yielded colors ranging from a light mottled grey to a jet black. Different proportions of saw- and coal dust were used to produce different hues, and the technique was used on red, buff, white, and a variety of slipped wares.

Mercer appears to have derived the staining technique directly from his archaeological experience. His inspiration was unglazed, low-fired Native American and African earthenware, which was usually covered

⁶²Indian House Record of Experiments, MPTW Records, Series 10, vol. 2, MPST; "Moravian Pottery and Tile Works Glaze Notebook," accession 85.3.1, collection of the Moravian Pottery and Tile Works.

with wood or dung and fired in pits.⁶³ Although he did experimental pit firings as well, his achievement was in developing a technique which produced a "primitive" effect within his regular production system. He did this by, in effect, reversing the traditional use of saggars. Instead of using saggars exclusively to keep fly ash and other impurities away from his wares, Mercer used them to concentrate these impurities upon certain of his wares for decorative effect. Each sagger became a small, relatively controlled reduction atmosphere within the larger kiln. With only slight modifications in loading the kilns, stained items could be fired in the regular glaze kilns (see firing description below). Although the staining technique was prompted by Mercer's archaeological experience and aesthetic judgement, its success resulted from his businessman's ability to simplify his production systems and contain costs.

Mercer also used colored glazes, which he called "enamels," to decorate his tiles. His limited palette consisted of eight colors (blue, green, two yellows, lilac, white, black, and brown). All enamels were applied to biscuit-fired ware in a single step. Although Mercer made little effort to produce realistically colored images, the predominantly dark and earth tone finishes yielded tiles of understated beauty. Mercer's "enamels" were applied by brush or by pouring. Hand-painting was used to produce tiles with a multi-colored finish. This technique was used primarily on the figurative brocade tiles. For quarry and flat decorative tiles, pouring was the preferred method of application, according to Mercer's kiln manual.⁶⁴ On relief tiles, the raised surface could be wiped free of glaze, producing a tile with red clay highlights and colored recesses. Mercer called these tiles "half-glazed."

Slips, thin clay solutions which were applied to the surfaces of the tiles, were an integral component of Moravian tile finishes. These matte finishes were applied to red clay tiles either alone or in combination with other underglazes and clear glazes to produce a variety of matte and shiny finishes. Green, blue, white, and buff slips were included in the colors offered in Moravian Pottery and Tile Works catalogs, while grey and pink slips were used primarily in mosaics. In addition to the Perrine, Page, and Tuckahoe clays, the Moravian Pottery and Tile Works purchased a buff clay from Billingsport, New Jersey which was used exclusively to make slips. The buff Billingsport slip was ordinarily stained or used in combination with additional underglazes and glazes, while the colored slips were usually final finishes.

⁶³A description of Mercer's experiments with the smoking technique appears in David Randall MacIver and C. Leonard Woolley, Areika (Philadelphia: University Museum, 1911), pp. 16-17.

⁶⁴Kilnmanual, MPTW Records, Series 9, Vol. 12, p. 4, MPSL.

The success of the slipping technique depends upon the "fit" between the slip and the clay body. They must shrink the same amount in drying and firing, or the slip may flake off. To achieve the best possible fit, slips were applied when the unfired tiles were just dry enough to handle without distorting. When the slip had dried, varying amounts of slip could be scraped off the tile. Mercer offered three different catalog finishes by using thick, medium, and thin slips with the same clay body and underglaze.

Slips were an essential component of one of the Moravian Pottery and Tile Works's most characteristic finishes, the underglazes. In 1900, Mercer patented his technique of applying slips, underglazes, and clear overglazes to relief tiles.⁶⁵ According to this system, a red clay tile was dipped into a slip of Billingsport clay and allowed to dry. If desired, some of the slip could be scraped away. Next, the tile was dipped into a colored underglaze. The underglazes were slips composed of ball clay, china clay, cornish stone, feldspar, flint, and pigments, all of which were purchased commercially. On their own, the underglazes fired to a matte finish. While the underglaze was still wet, it was wiped off the raised portions of the tile, leaving the raised design a buff color and the recessed portions the color of the underglaze. When dried, these tiles were biscuit fired. Finally, a clear glaze was applied over the entire surface of the tile, and it was fired a second time. The clear glaze gave the tile a rich, vivid color and a shiny surface. Because of the many layers of colorings, the surface of underglazed ware is unusually diverse, often showing traces of the red clay body, the buff slip, the colored underglaze, and the clear glaze. Underglazing became one of the best known characteristics of the Moravian Pottery's ware.

By varying the combination of slip thickness, underglaze, and overglaze, Mercer could offer a great range of colors and finishes using a very limited number of raw materials. He used two clear glazes in combination with his underglazes, one relatively colorless and one given to him by the English Arts and Crafts potter William de Morgan.⁶⁶ The de Morgan glaze contained a large quantity of red lead; this dramatically altered the colors below it, changing blue to green, buff to orange, and so on. Thus, by adding this one additional glaze to his repertoire, Mercer effectively doubled the number of underglaze colors he could offer. It is a mark of Mercer's business acumen that he developed this relatively simple and aesthetically striking underglaze technique into an efficient system of production.

⁶⁵U.S. Patent 644,530 (27 February 1900).

⁶⁶HCM, "Notes," p. 484.

The Kilns

The Moravian Pottery and Tile Works is equipped with five brick bottle kilns. The two large kilns in the east wing, called "biscuit kilns" in the Tile Works records, have a firing chamber capacity of about 460 cubic feet each, while the three smaller "glaze kilns" in the north wing each hold about 180 cubic feet of ware. Appropriately-sized openings were left in the concrete floors and roof of the west wing for an additional glaze kiln and of the east wing for an additional biscuit kiln. These kilns were never built.

During the Pottery's heyday, one biscuit kiln was fired approximately every month.⁶⁷ It is doubtful, however, that either large kiln has been fired since 1930. Business dropped off sharply in that Depression year, and although the Pottery survived, the smaller glaze kilns were sufficient to meet the reduced demand of the 1930s, '40s, and '50s. Between 1912 and 1930, a glaze kiln was fired every week on average. This figure, too, dropped in 1930, but the glaze kilns continued to produce tile until Frank Swain's death in 1954. A subsequent owner, Raymond Buck, Sr., modified glaze kilns No. 2 and No. 3 to burn oil in the late 1950s, but met with little success.⁶⁸ Glaze kiln No. 1 is the least altered of the small kilns, and was returned to operation by Bucks County in 1975. It was fired several times a year through 1984, and is now awaiting restoration.

All five kilns at the Moravian Pottery and Tile Works are of a two-chamber, combination updraft/downdraft design. Although the internal configurations, and therefore the operating procedures, of the glaze and biscuit kilns differ somewhat, the general principle is the same. All the kilns have holes in the crowns of the lower, or ware chamber, and flues built into the floors and walls of the kiln. Both crown holes and wall flues open into the upper chamber of the kiln, which connects directly to the chimney. The upper chamber has an arched opening on the second floor of the pottery, through which the covers for the crown opening and flues are manipulated. This opening was bricked up after the crown hole was closed and downdraft firing began, thereby converting the upper chamber into an extension of the chimney.

The following description of the glaze kiln firing technique presents the basic principles of the updraft/downdraft design. The variations

⁶⁷Kiln Records, MPTW Records, Series 6, Vols. 1-3, MPSL.

⁶⁸Personal interview with Raymond Buck, Jr., 23 July 1985. The oil fired kilns gave a very different finish to the tiles than did coal. The Bucks unsuccessfully attempted to imitate the effects of a coal atmosphere by sprinkling the green tiles with sulphur.

employed by the biscuit kilns will be discussed immediately following. With crown openings uncovered, the glaze kiln operates in an updraft fashion. In this firing mode, heat rises directly upwards through the ware and exits through the crown opening to the chimney. The attendant heat loss is wasteful of fuel, but insures that the tiles are completely dry before reaching critical temperatures.

To bring the tiles up to their maturing temperature of cone O6, the kiln is converted to downdraft operation during the middle and later stages of firing. The crown opening is closed off, forcing the heat back down through the ware to the flues in the kiln floor. From here it is drawn outward and up through the wall flues, to the upper chamber, and out the chimney. Downdraft firing produces a more efficient use of fuel and a faster, hotter, more even heat. The tall chimneys of the Moravian Pottery and Tile Works kilns provide the extra draw that is necessary in downdraft firing.

Unlike the glaze kilns, which have two fireboxes and two wall flues each, the biscuit kilns each have four fireboxes and four wall flues. Each also has a closed central chimney which runs through the center of the ware chamber, connecting the floor flues with the upper chamber. Because this chimney closes off the center crown opening, two additional holes have been made in the crowns of the biscuit kilns to maintain updraft firing capability. The central chimney operates during downdraft firing, just as the wall flues do. Like the glaze kilns, the biscuit kilns are initially fired in an updraft mode to dry the tiles, then converted to downdraft firing to bring the ware to temperature.

The updraft/downdraft design of the kilns provided a sophisticated level of control over the internal conditions of the kilns during firing. This control was particularly well developed in the two biscuit kilns. Small openings in the kiln walls on the second floor of the pottery allow each of the wall flues to be opened or closed independently, even after the upper chamber has been bricked up for downdraft firing. In response to such variable external conditions as humidity, precipitation, and wind direction, each quadrant of the kiln can be either banked or encouraged to burn hotter, helping maintain an even kiln temperature.

Firing

Once the tiles were dry, they were loaded into saggars for firing. Although the Moravian Pottery and Tile Works records consistently refer to the small kilns as "glaze" or "gloss" kilns, and the large ones as "biscuit" kilns, these terms do not reflect actual practice. Biscuit firing is a relatively low temperature firing intended only to harden the ware enough to be handled easily, while leaving it porous enough to accept a glaze and

be refired. Some biscuit firing at the Moravian Pottery and Tile Works was actually done in the glaze kilns. Mercer himself explained that "our custom has been to burn glaze and biscuit together, utilizing the fact that the lowermost two saggars of a gloss kiln never heat beyond [cone] 08, while the top of the kiln is at [cone] 06."⁶⁹ The similarly misnamed biscuit kilns were used for the final, or "finish" firing of quarry tiles, although internal temperature differences probably also produced biscuit ware in these kilns.

Temperature variation inside the kilns was only one of the firing difficulties that Mercer had to overcome, or more precisely, turn to his advantage. Each type of finish had its own set of optimal firing conditions, and each affected the firing conditions of the ware around it. The variables to be considered in any given firing were considerable. Based on experience and close observation of results, Mercer therefore developed a complex set of instructions for setting the kilns. For the workers, loading each glaze kiln must have resembled trying to solve a Rubik's Cube puzzle.

Enameled, glazed, underglazed, stained, and biscuit tiles were all fired in the same kiln. The ware was sorted by finish and color and loaded into saggars. Each glaze kiln held six vertical columns, or "bungs," of saggars placed one to two inches apart, with each bung stacked up to seven saggars high. Placement of individual saggars inside the kiln was critical.

One danger was "frosting," or the undesired appearance of a dry, matte finish on glazed tile. This happened if the overall proportion of biscuit ware in the kiln was too high, or if a sagger of stained or smoked tiles was placed just above or just below a sagger of glazed tiles. Frosting could be prevented, however, by placing a sagger of plain biscuit ware between the glazed and stained tiles, or by moving the glazed ware to the adjacent bung. The frosting phenomenon occurred vertically within the same bung, but not horizontally between bungs.

Temperature was equally critical in placing saggars. The enamels did best at high heats, and so went in the top of the kiln, but even these had gradations. Blues and yellows, which needed the most heat, were placed in the top two layers of saggars, the sixth and seventh from the bottom. Whites and browns went in the fifth and sixth saggars, while greens could be placed as low as the fourth sagger. In contrast, the de Morgan clear glaze required low heat and was fired in the bottom three

⁶⁹Kilnmanual, MPTW Records, Series 9, Vol. 12, p. 5, MPSTL. The following discussion of firing technique is based upon Adam Zayas, "The Processes and Formulae of the Moravian Pottery and Tile Works as They Relate to Henry Chapman Mercer's Original Catalogue Offerings," unpublished paper, 1989.

layers of saggars. These lowest layers were also used for biscuit and stained ware, and there were variables here as well; the lower in the kiln stained ware was placed, for example, the blacker the result. The underglazed ware had its own set of requirements. Overall proportion of ware was important as well. A kiln containing more than one third stained tiles tended to overflux clear glazes and burn the color out of underglazes.

To obtain consistently successful results from the Pottery's kilns demanded considerable skill and experience, as well as the ability to think in three dimensions. But equally important was the factory's product mix. Even if it had been desired, the kilns were not capable of producing exclusively enameled, underglazed, or any other single type of tile. The stained and underglazed tiles, in addition to their aesthetic merits, maximized the saleable yield from each firing by utilizing the lower, cooler levels of the kilns. Similarly, because biscuit ware was useful in mitigating frosting and other firing problems, Mercer was wise to develop a line of tile, the underglazes, which utilized this process. The range of tiles produced at the Moravian Pottery and Tile Works maximized the productive capacity of the factory's kilns, both by maintaining tile quality and by increasing marketable output. Mercer's tight control over process and attention to the economic impact of his technical decisions were instrumental in the Moravian Pottery and Tile Works's long financial success.

The kiln firing itself required the better part of two days, though the duration varied considerably "depending upon draft, pressure of the atmosphere, kind of coal, previous attention, and climatic conditions not understood."⁷⁰ Adam Zayas, the Head Ceramist at the Moravian Pottery and Tile Works, has summarized Mercer's kiln manual, notebooks of experiments, and other firing records into the following basic summary of the Pottery's glaze kiln firing procedure:

After the kiln was loaded and the door to the firing chamber was bricked up, kindling wood and anthracite coal were used to begin the firing. This normally occurred in the afternoon. The crown, dampers, and firebox doors would be left open. This would allow any moisture left in the ware to be driven off. The fires would be banked overnight.

In the morning, at about 7:30, the crown would be closed and the upper chamber would be bricked up. This procedure converted the kiln from an updraft to a downdraft operation, resulting in a more efficient fuel usage and increased kiln temperature. The door to the firing chamber would be tightened with turnbuckle screws, as the kiln tended to expand from the

⁷⁰Kilnmanual, MPTW Records, Series 9, Vol. 12, p. 4, MPSL.

heat, loosening the fit of the door.

The kiln, now tightened and operating in a downdraft fashion, was coaled every three hours. At each recoaling the fire was first raked, and the ash pit was cleaned, before coal was added. The kiln was recoaled until cone 08 was half down, some time between 9 p.m and 3 a.m. Mercer tried for an interval of approximately seven hours before cone 06 arched and its tip touched cone 07, while still leaving a hollow under itself. At this point, some time between 4 and 10 a.m., the fire was pulled, the ash pits were shoveled out, and the firebox doors and ash holes were sealed.⁷¹

Mercer's own description of the process is considerably more detailed, including recommendations for controlling heat rise, placing the pyrometric cones, varying procedures for kilns with special contents, and using bituminous coal under certain circumstances. Although burning kilns remained an art rather than a science, Mercer's powers of observation and deduction produced a detailed empirical guide to the process.

Instead of the original bottle kilns, the Moravian Pottery and Tile Works currently uses modern gas and electric kilns. The first electric kiln was installed under the ownership of Raymond Buck, in the late 1950s or early 1960s. Although the initial efforts at reactivation of the pottery in the mid-1970s employed an original coal kiln, it became clear that a limited staff could not produce enough ware to fill more than one or two kilns per year. Since this could not supply the steady income needed to fund the reactivation project, the burden of production was shifted to three smaller electric kilns. Until 1984, glaze kiln No. 1 continued to be fired several times a year in connection with the Pottery's three-month apprentice programs. It is now awaiting restoration. In 1985, a 27 cubic foot Bailey propane kiln (Model PRO 21FL) was installed. In 1987, a new twelve cubic foot Unique electric kiln (Model PRO 2436) replaced one of the older ones. The factory also uses a one and a half cubic foot Unique electric kiln (Model 570) of unknown age.

Marketing

Once the tiles were fired, they were carried to the west wing of the factory for storage in built-in concrete bins and shelves on the first floor. Orders to be shipped were packed in sawdust inside recycled wooden barrels. Mercer regularly purchased used barrels from local merchants.⁷²

⁷¹Adam Zayas, "The Processes and Formulae," pp. 5-6.

⁷²Sales/Expenses, MPTW Records, Series 9, Vols. 1-3 and Uncataloged Receipts, MPTW Records, MPSL.

The barrels were hauled by horse-drawn wagon to the Doylestown railroad station for shipping. The horse and wagon were housed in the stable just north of the factory, and were in regular use for hauling materials, supplies, and finished ware.

Mercer sold Moravian tiles through a number of venues.⁷³ Indian House, whose walls were hung with samples, served as the showroom for local customers. Family connections were also important in the factory's early years. Mercer's Aunt Elizabeth Chapman had married into the Lawrence family of Boston, and through her and his own years at Harvard, Mercer obtained a number of influential clients. One of his earliest major sales came in 1901 to Isabella Stewart Gardner for her mansion at Fenway Court, now the Isabella Stewart Gardner Museum. Mercer had equally good connections to Philadelphia society.

Mercer showed tiles at museum and craft shows. He exhibited frequently at the Pennsylvania Academy of Fine Arts and at other Arts and Crafts oriented trade shows, like the Exhibition of Art Craftsmanship in Rochester, New York in 1903. Perhaps his greatest public honor came in 1904, when his entry won a grand prize at the Louisiana Purchase Centennial Exhibition in St. Louis.

Mercer also sold his ware through established Arts and Crafts networks. The Society of Arts and Crafts, Boston was the foremost of these, carrying Moravian tiles from 1901 on. Arts and Crafts guilds in many other cities also sold Moravian tiles.

Beginning in 1901, the Moravian Pottery and Tile Works also published a catalog to enable builders and architects, as well as the general public, to order directly from the factory. The factory published four catalogs and numerous supplementary flyers and inserts during Mercer's lifetime. It was usual for prospective clients to send specifications and/or blueprints and ask for prices and proposed designs. The Tile Works records contain year by year files of these inquiries, along with the factory's replies, price calculations, and design drawings. These records show that the factory had ongoing relationships with several architects, who placed repeated orders stretching over many years.

Somewhat less clear is the relationship Mercer had with his sales agents. As early as 1899, a number of design firms and individuals in various cities were responsible for promoting and selling Moravian tiles. The nature of their business connection to the factory requires further research. Some, like lawyer John Hall Ingham, a childhood friend of Mercer's, apparently had other occupations and sold Moravian tiles as a

⁷³The following discussion of Mercer's marketing techniques is based largely upon Reed, pp. 75-84.

sideline. In any case, considering his numerous other sales outlets, Mercer's agents do not appear to have been critical to the overall success of the business. The variety of these marketing outlets is additional evidence that Mercer was, or became, a sound businessman as well as being an artist and designer.

Later Site History

Henry Mercer died in March 1930. In his will, he left the Moravian Pottery and Tile Works to his factory manager and friend of 34 years, Frank King Swain. Swain carried on Mercer's production techniques and systems faithfully, operating the factory as much as a memorial to Mercer as a money-making enterprise. Though forced to cut the staff to two for a time, Swain managed to carry the business through the Depression. He continued to operate the pottery at a much reduced production level until his death in 1954.

Swain, who had no children, left the pottery to his nephew Frank H. Swain. The latter Swain, who had no previous connection to the pottery and was evidently surprised at the bequest, operated the factory for two years, relying upon the skill and experience of veteran employees. After making several changes, such as adding electricity, he sold the factory to Raymond Buck in 1956. Buck had no ceramic background, and was less successful than the younger Swain in getting along with the employees. Within six months of his arrival, all the men who had worked under Mercer or Swain had left. Buck dabbled with the pottery, selling off existing stock and unsuccessfully experimenting with commercial glazes and new techniques. He modified two of the glaze kilns to burn oil and installed the first electric kiln at the site.

In the early 1960s, Buck tried to interest Bucks County in buying the property as an historic site. The Mercer Museum was open to the public and Frank Swain's widow Laura gave occasional tours of Fonthill. The County was interested in the site, but not at Buck's asking price. Instead, it condemned the property in 1964 and, after a drawn-out legal wrangle over its assessed value, took possession in 1968. After a preliminary inventory and some physical improvements, including new toilet facilities, walkways, lighting, and reception area, the Moravian Pottery and Tile Works opened to the public in 1969 as a museum. It featured historic tiles and static displays, using mannequins, of the production process.

A pilot project was undertaken in the summer of 1975 to determine the feasibility of resuming tile production. Wayne Bates, a ceramist from the Philadelphia College of Art, was hired to oversee duplication of glazes and the manufacture and firing of reproduction tiles. Based on the positive

results of the first summer, production was resumed full-time in 1976. Because the Tile Works records were still largely unexplored at this time, new glaze formulae had to be developed and other production techniques were approximated. Some concessions to modern efficiency, such as the construction of new presses and the use of a slab roller and electric and gas kilns, were made. Throughout the re-activation process, however, the objective was to produce tile that was as faithful to Mercer's aesthetic vision as possible.

Additional research over the past ten years has deepened the staff's understanding of the factory's original materials, products, and manufacturing techniques. Wherever feasible, this knowledge has been incorporated into the modern operation of the factory. As this is written, the Moravian Pottery and Tile Works serves as both an educational institution and a manufacturing enterprise. The sale of historically faithful Arts and Crafts tiles helps support its mission of interpreting the significance of the factory, its wares, and its creator to the public.

ABBREVIATIONS

The following abbreviations have been used in various places in the text and footnotes.

BCHS Bucks County Historical Society

FM Fonthill Manuscripts

HCM Henry Chapman Mercer

MPSL Mercer Papers, Spruance Library, Bucks County Historical Society

MPTW Moravian Pottery and Tile Works

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The papers of Henry Chapman Mercer are housed in the Spruance Library of the Bucks County Historical Society in Doylestown, Pennsylvania.

Mercer's personal papers, Group 1 of the collection, includes correspondence, research notes, scrapbooks, archaeological and architectural notebooks, sketch books, and a variety of other items, gathered from various locations at the Mercer Museum, Fonthill, and the Moravian Pottery and Tile Works. Most of this material is by Mercer himself, but the papers also contain documents compiled by Mercer's longtime friend and pottery manager Frank King Swain. While all of these items will eventually be incorporated into a single collection, some items cited in this paper retain their earlier designation as part of the Fonthill Manuscripts.

The business records of the Moravian Pottery and Tile Works also survive, and are in the care of the Spruance Library. These records, Group 2 of the collection, include correspondence, drawings, order books, printed catalogs, kiln logs, sales and expense ledgers, records of experiments, and other miscellaneous records.

The most important of the personal and business records were microfilmed in 1985, and are described in Terry A. McNealy, ed., *Guide to the Microfilm of the Papers of Henry C. Mercer and the Records of the Moravian Pottery and Tile Works*. Doylestown, Pa.: BCHS, 1985.

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